

A Dissertation
on the
Proximate Cause
of
Inflammation

Philadelphia.

1812

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A Dissertation In

The present is an age so replete with discoveries in science & with improvement in the arts, that philosophers are every day becoming less obdurate at innovation; & the inventor of a new theory stands a much better chance now, than formerly of obtaining a hearing & of escaping persecution. We have been so much accustomed to smile at the errors, both speculative & practical, of the great men that have gone before us, that we hardly dare to enlist under the banners of any Master, however splendid his genius, or extensive his learning. A few years will away, & he & his opinions are quite out of fashion. New facts are observed, new experiments are made, which set three fourths of the medical world to wondering, & the remainder to speculating. At length a path is laid to form; mortality steps forward with a new theory, and

— "sets his hour upon the stage,
And then he is no more."

— of our country.

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Such will ever be the state of things, when the truth of any theory, or system can only be inferred from observation, which may have been incorrect, or from experiments, which may have been carelessly conducted or partially stated. It is from this circumstance that so many disputes have arisen about the proximate cause of inflammation. From Hippocrates, down to the present time it has excited much interest, & given rise to much speculation. Many of the theories on the subject are absurd, & some of them so far from correct, that they ought not to be mentioned for the sake of their authors. The false notions of such men as Boerhaave & Cullen, like the unavoidable failings of the virtuous & the good, ought to be blotted from the memory of every philosopher.

The question now is, whether inflammation depend on an increased, or diminished action of the vessels of a part inflamed. Those, who favour the idea of increased action, maintain, that the arteries of an inflamed part not only contract, but dilate their diameters beyond

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what is natural to them in a healthy state. By this increased dilatation, a greater quantity of blood passes through them in a given time than was wont to be the case; those minute branches, which before carried only the coloured part of the blood, now become visible from admitting the red globules of that fluid. Is this manner the part inflamed becomes tumefied, & there exists in it pain, with increased redness & heat. This, if I mistake not, was the notion entertained upon the subject by Mr John Hunter, Blarum & venerable women! But it is contradicted, in opposition to such high authority, that inflammation depends, not on an increased, ~~longitudinal~~ action of the blood vessels, but, on a diminished proportion of the mass of the capillaries to the red a tissue. Thus, there is an accumulation, or partial stagnation of blood in the parts inflamed. By what they, instead of shewing an increased action, shows the direct contrary, a diminished action.

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This is the idea I have ever entertained upon the subject, suggested, not by books, but by observation. I mention this, not because I wish to lay any claim to originality, but to convince only such honoured instructors that it is not from any want of deference to their opinion, that, I have ventured to express my sentiments on so interesting a subject as that of the present dissertation.

That the phenomena of inflammation depend on diminished, rather than on increased action of the blood-vessels, I infer,

- I. From the anatomy of the parts concerned in inflammation,
- II. From some of its remote causes,
- III. From some of its most successful modes of treatment, &
- IV From the experiments of Dr Wilson & of Dr Stensen

I. It is now proved that, the arteries are not mere elastic tubes, through which the blood passes to every part of the body, like water through a hose.

... of our complex...

The first part of the paper is devoted to a
 description of the various species of the genus
 which have been hitherto described. The author
 then proceeds to describe the new species which
 he has discovered. The description of each
 species is given in a separate paragraph, and
 is accompanied by a figure of the animal.
 The figures are drawn by the author, and are
 very accurate and well executed. The paper
 is well written, and the style is clear and
 concise. The author's conclusions are well
 stated, and are supported by the evidence
 which he has presented. The paper is a
 valuable contribution to the knowledge of the
 genus, and is well worth reading.

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Like the heart, they are endowed with muscularity; so that, independent of their elasticity, they can contract their diameters upon the application of an irritant, or the stimulus of distension. In proportion as the arteries recede from the great centre of circulation, this muscularity is observed to increase, & is evidently intended to cooperate with the heart in transmitting blood to every part of the body. Performing a similar office with the heart, we must suppose they perform it in a similar manner. What, then, is the action of the heart? Physiologists are generally agreed that, both the auricles & ventricles are wholly passive in their diastole. They allow themselves to be distended to a certain extent, & then, from their irritability, contract upon the volume of blood forced into them by the vis a tergo. I never heard it suggested that, the muscles of the heart are ever endowed with the power of dilatation.

— of our system.

There is no need of supposing such a power. We are to admit no more causes of things, than are sufficient to explain appearances. Such, then, is the action of the heart. Have we any reason to believe that the action of the artery is different? Certainly not. The force, with which the blood is sent from the left ventricle of the heart, is surely sufficient to extend the coats of the artery at its commencement; the muscular contraction of this part of the artery, added to the vis a tergo, is sufficient to disend a section; the muscular power of this a third, & so on to the minutest ramification of the arterial system. There is then no need of supposing a double action of the arteries! We may even go further, & say that, such an action might be attended with serious & even dangerous, if not with fatal consequences. At any rate, it could not produce inflammation.

Elasticity & extensibility vary as much in the arteries as, in any other part of the body.

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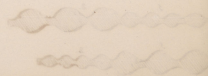


& they may be diminished or increased through-
 out the whole of the arterial system, or in part
 of it only. Suppose excitement to be partial, as
 represented in the two figures A & B below. It
 is evident that the quantity of blood in portion
 1 of Fig. A can never fill portion 2 of the
 same figure. Hence, if we suppose portion 2
 to be excited into greater dilatation than por-
 tion 1, it will form a vacuum. Again, al-
 lowing the excitement of portion 1 of figure B
 to be greater than portion 2 of the same fig-
 ure, it is evident that, if portion 2 will not
 dilate so as to admit all the blood in portion
 1, there will be a regurgitation. We see, then,
 by the first of these figures, that an increased
 action of dilatation will not account for the in-
 creased volume of blood in an inflamed part.

Since muscles, as far as we know, contract
 themselves ^{by} on the application of a stimulus, yet



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may be asked, what stimulus is applied to produce contractions, when they have dilated themselves? We cannot suppose that the same stimulus, which induced their dilatation, will, in the twinkling of an eye, induce them to contract. We are then to look for an antagonist stimulant; which, I imagine, will remain yet for some time among "the hidden things" of physiology."

A late Reviewer has observed that, there can be no more absurdity in supposing an action of dilatation, than of supposing an action of contraction; because, we must ever remain in the dark as to the real mode, in which either of them is performed. This is very weak reasoning. I will grant that we cannot explain the manner, in which muscular contraction is produced: But, if there is no necessity of supposing an action of dilatation, he is guilty of an absurdity who supposes it. Should there not be an apparent absurdity in saying that, the biceps muscle of the arm has a power of extending it, when we observe two muscles the anconeous & triceps made for this express purpose? And is not the absurdity heightened,

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The action of the arteries, then, resembles in every respect that of the heart; & being endowed with a muscular coat, must be subject to the laws of muscularity. Irritability is one of the most striking characters of a muscle. If this irritability be increased, the application of a life stimulant will be necessary to excite it into action, & vice versa. If, then, the irritability of an artery be increased, it will reach upon a much less volume of blood, than in its ordinary state of excitability. Whenever, therefore, we observe the pulsations in any part of an artery to be fuller than ordinary, & fuller than the same artery on an opposite side of the body, although ~~the pulsations~~ ^{the pulsations} of the one may be perfectly synchronous with those of the other, we may conclude that the former has lost part of its excitability, or that, in other words, it labours under indirect debility. Now, when this is the case, as it has to push forward a greater quantity of blood, it is evident that it cannot act to the same

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extent even if it act with the same force as in its healthy state: Of course, there will be a retardation, or partial stagnation of blood. This retardation is favoured, in, at least, six times out of ten, by diminished action in the veins: for, there is such an intimate connection between the arteries & veins, that, whatever tends to diminish the power of the one, must produce a similar effect upon the other. I know it is supposed by some that, the veins have little or no action, & that, the principal cause of the passage of the blood in them is the combined action of the heart & arteries. "But", as Richerand observes, the propulsion force communicated by these organs "is lost & obliterated in the system of capillary vessels, & does not extend to the veins. The action of their own coats, assisted by some extrinsic powers, is sufficient to cause it to move on to the heart. The capillary arteries, winding in a peculiar manner, in conjunction with the veins & the lymphatics, form a surprising network in the texture of our organs."

From this account of the anatomy of the parts in which inflammation is seated, it is evident that, increased action will not account for the phenomena of inflammation. It will not account for the tumefaction of an inflamed part. We cannot suppose increased action of the arteries in, at least, a majority of cases, without supposing also an increased action of the veins & lymphatics. In this case the volume of blood ought rather to be diminished than increased.

II I come now to notice some of the remote causes of inflammation: However it may be produced, & wherever it may be seated, inflammation must be considered as a unit. Hence it is quite unnecessary to mention all its remote causes, or to dwell upon their peculiar mode of acting. Inflammation may be divided, with respect to its remote causes, into constitutional & foreign. Constitutional inflammation may arise from morbid action of the whole arterial system being thrown upon the predisposing debility of a

of a particular part; as, upon the lungs in pneumonia, upon the liver in hepatitis, upon the kidneys in nephritis &c. Foreign inflammation may arise from any external violence done to a part, either by chemical, or mechanical means. I select for my present purpose the chemical remote causes, Heat & Cold. It is not strange that the painful symptoms arising from burns & scalds should tend to confirm physicians in the belief that, increased action takes place in every case of inflammation. Heat, we know, is a most active element; & we are very apt to imagine, when it has produced mischief of facts, upon the body, that its presence is not immediately withdrawn, & that, the phenomena of inflammation which succeed its prostration are owing, in a great measure, to its continued agency. Hence, we hear so much about "drawing out the heat" &c. Such associations are very natural, but they are very mischievous.

The proximate cause of this species of inflammation cannot be increased action of the blood-vessels

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the apostle shall be the parting of my home I shall descend quarter of an hour or so. I hope by that it is a note. How our primary now do perhaps, twisted will come much better. Just as to me a been an experience

sels. It is a law of the animal economy that, the application of violent stimuli to any part shall be succeeded by indirect debility of the part. Daily experience shows us that, when the system is raised above the grade of healthy excitement, she must retrace her steps, & descend below it. And this she does with greater or less rapidity, as the excitement is more or less removed above the healthy standard. She does it sometimes so instantaneously, that it is often difficult to determine whether or not any excitement has been produced. How many disputes have arisen about the primary effect of opium & digitalis? These are now ascertained to be powerful stimuli. Yet, perhaps, the very same persons, who once contended that they both act directly as sedatives will contend that increased action is a permanent effect of the powerful stimulus of heat. But, it seems as irrational to expect the stimulating effects of this element to remain for weeks after it shall have been withdrawn, as to look for elevated excitement a day or two after giving a large

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dose of laudanum. The application of heat to the body, I contend, is perfectly analogous to that of every other stimulant. It produces, when carried to a certain extent, indirect debility in all its forms, & even death: According to Burns are divided into four degrees:

"1st In the mildest, there is but a slight ^{redness} without swelling, & only a gentle inflammation is excited, that shortly subsides."

"2nd In the second degree the redness is attended with swelling, the pain is severe, the inflammation is acute, but it commonly ends in resolution."

"3^d In the third degree vesicles containing a clear or yellow fluid arise in a sudden or gradual manner, the pain is intolerable & suppuration can seldom be prevented."

"4th In the fourth degree the burnt part is mortified. This happens either at the moment of the accident or shortly after."

Increased action in all these cases takes place immediately on the application of heat: To this, in proportion as it has been applied,

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succeed the various grades of debility. Inflammation seems here, at least, to depend not on a strong, but weak action of the vessels.

Nature seems to have endowed the cartilages with greater strength, on purpose to guard them from the great body of blood pressing upon them from behind, & ready at any time to overwhelm them. Accordingly, when their strength departs, the blood behind pours in upon them, as did the barbarous natives of the North upon the Roman Empire, when enfeebled by luxury, & debased by corruption.

Having thus noticed the effect of an indirect sedative upon the blood-vessels, it remains to show in what manner inflammation is produced by the direct ^{one} of cold. It is well known that the abstraction of heat, suddenly & to a great extent produces the same sensation & the same effects, as the addition of it would have done. Pelletier the chemist suffered very severely from dropping into his hand a piece of frozen mercury. The sensation was much the same as if an equal quantity

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quantity of fire had fallen upon his hand, &
 the same effects followed. The Chilblain is
 known to almost every one by sad experience.
 It is produced by the sudden warming of a cold
 part or the sudden cooling of a heated part.
 Like the inflammation of burns it has four
 degrees, & sometimes ends in mortification.
 It would seem not a difficult task to prove
 debility, in all these cases, to be the proximate
 cause of the inflammation; since, cold is a seda-
 tive, & must, therefore, produce direct debility
 by .. Inflammation, however, does not succeed as
 the immediate effect of the application of cold
 to the body. Increased action of the vessels is the
 first step, & is produced either by the applica-
 tion of heat or some other stimulus to their
 increased excitability. Debility from action soon
 succeeds, & is followed by inflammation. Na-
 ture is prompt in her operations, & all this,
 I conceive may be accomplished in a very
 short time; often, almost instantaneously; as was
 the case with the frozen mercury mentioned
 above. That this is the real state of the case,

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I infer from the effect of sudden heat applied to a frozen part, which, by acting on the accumulated excitability, produces almost instant mortification. Here, the part is prostrated as suddenly, as the whole system would have been in a healthy state by a violent shock of electricity. Had the part been less excitable the very same stimulus would only have produced inflammation. Both effects however are prevented by the gradual application of heat so as to exhaust excitability & to produce health of extremity.

Such, then, is the manner in which inflammation results from the two chemical agents Heat & Cold. I could show, if necessary, how the same effects result from the operation of mechanical causes. But, as they are all a unit in their operation, they may all be explained upon the same principle.

III That the position I have assumed respecting the proximate cause of inflammation is correct I infer, farther, from the modes of treating inflammation that have been found most successful, more especially, from the approved method

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of treating burns & scalds. Mr B. Ball says that, in some cases emollients give relief; but, in general, astringent applications are the best. He praises particularly strong brandy or alcohol. According to him the part should be immersed in spirits, & when this cannot be done, soft old linen soaked in them should be kept constantly on the burn. Mr Cleghorn used warm vinegar, placing the patient, in cold weather, near a fire. Sir cold water & ice of Sir James Esq act only as astringents. Mr Hentish, on very angry popples, recommends holding the part to the fire. If that cannot be done he recommends that, we should resort to the strongest sterner lents, as, rectified spirits, made still stronger by essential oils. Dr Wilson found that, when he applied spirits to the inflamed foot of a frog, the inflammation ceased. The blood-vessels, which before were preternaturally dilated now returned to their former size & the blood which before almost ceased to flow, now began to move with its

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accustomed clarity. How completely inexplicable are these facts upon the principle of increased action!

Inflammation from cold is also treated on the stimulating plan. It is recommended to rub the parts affected with spirits of wine three times a day. ~~It is also recommended to rub the parts affected with spirits of wine three times a day.~~ A mixture of ol. turpenth. & balsam capivi in equal parts is a celebrated remedy. A mixture of compound spirit of wine has also been very highly recommended.

But, the stimulating plan of treatment is not confined to the above species of inflammation. Its good effects are more or less striking in erysipelas. I have tried it not only on myself, but on others. In a very short time the progress of the inflammation may be stopped & finally removed. My method was to pour about half a pint of whiskey from a little height upon the inflamed part, & then to rub it with the spirit. In this way I soon reduced an erysipelatous inflammation, that was extending rapidly from my foot

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up the leg. My friend Dr R. after much persuasion, at last permitted me to try the same experiment on himself. He had for some time been troubled with erysipelas in the face, which he had endeavoured, in vain, to remove. The opiate suddenly relieved him, & he was well in two days. It is unnecessary to enlarge further on this point. As is remarked by Dr Wilson "a single fact showing that, local stimulations are our first & best applications to inflamed parts, is of itself a host of reasons against the prevailing doctrines on this subject."

IV. What has been said in favour of dominical action as the proximate cause of inflammation receives additional support from the experiments of Dr Wilson. He says,

"the inflammation" had been excited some hours in the web of a frog's foot. Having applied to it a microscope, I found the vessels of the part greatly dilated & the motions of the blood extremely languid. In several places where inflammation was greatest it ceased altogether. It was evident that, when the inflammation

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"was greatest, the vessels were most dilated & the
 "motion of the blood slowest. The distention of the
 "vessels, which, in the healthy state, admit only
 "the colourless part of the blood, was apparent;
 "for in inflamed parts a much greater number
 "of ~~thousand~~ vessels admitted the red particles
 "than in the sound, & the interstices of the red
 "vessels appeared more opaque, probably from
 "the enlargement of innumerable small vessels
 "still too small to admit the proper parts of
 "the blood."

"While I was viewing the inflamed web I re-
 "solved that, if I could succeed in stimulating its ef-
 "fets into action, I could thus remove inflammation.
 "With this view, I wetted the inflamed part with
 "distilled spirits, at the same time throwing upon
 "it the concentrated rays of the sun from a burning
 "candle. The speculation by a microscope. The
 "blood in all the vessels, except those in the most
 "inflamed parts, began to move with the great-
 "est velocity, & in proportion as this took place
 "& the redness became evidently less remarkable,
 "the web seemed pale, & the interstices became less
 "opaque."

"The blood, and the vessels of the web, are of one colour."

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Inflammation was then observed in the fins & tail of a fish. The experiment with spirit was repeated, & with the same result. An experiment was next made on the intestine of a rabbit. & exactly the same appearances were observed here as in the two former cases.

A part of Dr Wilson's experiments have been repeated by Dr Stevens; & he also found that diminished & not increased action attends inflammation. To an impartial mind, these experiments must appear perfectly satisfactory. But, an objection has been urged against them by a late Reviewer. He does not call in question the veracity of Dr Wilson or of Dr Stevens, yet he thinks these gentlemen could not have seen what they have so accurately described. He says, they selected transparent objects in order to observe the changes that might take place; now then, he asks, could they ascertain that the blood moved slower in the inflamed, than in the sound part of the frog's web, if it became opaque. This is a serious objection if the experiments thus

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gentlemen have made use of one to be taken
 in their literal sense. But, ~~these~~ are not to
 look upon Dr Wilson & Dr Fleming, as a second
 and Falstaff, who pretended to discern "three miles
 forgotten knaves in Kendal green," when it was
 so dark he could not see his hand before
 him. They meant to say, merely, that, the
 flamed part of the page will become less trans-
 parent; but still, not so opaque as to be com-
 pletely impenetrable to light. I believe they
 both saw what they have related; & for this
 reason: In the experiment made by Dr Wilson
 on the intestine of a rabbit, he did not choose
 to trust his own eyes, but after viewing the
 inflamed part himself, submitted it to the ob-
 servation of Mr Boraston, who was already un-
 acquainted with his view in making the
 experiment. Mr Boraston may therefore be
 supposed to have given an impartial ac-
 count of what he observed. This account
 Dr Wilson has given in his own words, &
 is intitled to full credit, till
 similar experiments are made with different
 results.

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I must confess that, I am not perfectly satisfied with Dr Stevens's definition of the proximate cause of inflammation. In one part he has gone too far & in another not far enough. I do not understand how debility & morbid action can exist in the same part ^{thing} at the same time. Dr Stevens, too, should have said that inflammation arises from absolute as well as relative debility of the small vessels. - It is, however, a difficult thing to give a very concise definition of the proximate ^{the} cause of a disease. We usually mean by it the disease itself, & therefore, it is necessary to enumerate all those particulars which constitute it ^{the} what it is. If this be true, inflammation, or what is the same thing, the proximate cause of inflammation, may be defined.

That state of a part, in which there is absolute or relative debility of its smaller vessels, inviting the retardation, or partial stagnation of a greater quantity of blood, than is natural to it in a healthy state.

appearing too, and so we view a term of our inquiry.

[Faint, mostly illegible handwritten text, possibly bleed-through from the reverse side. The text appears to be organized into several paragraphs.]

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I have thus endeavoured, & I hope it
 will not be thought presumptuously, to disprove
 the doctrine of increased action. After all, it
 may be asked, of what use is all this conten-
 tion about the proximate cause of inflamma-
 tion? It has been successfully treated by the
 followers of Boerhaave, & Cullen & of Hunter
 & if we should chance to be right, & they to
 be wrong its mode of treatment must continue
 as we found it. This may, perhaps, be
 true: But, in reply, I will say that many
 a blind man has found his way, by grop-
 ing & by blundering, for years, perhaps, into
 every lane, alley, & street of London or Phila-
 delphia, but, should he then find the safe gate-
 way of all at once he should be enabled to
 proceed quicker & surer by the blessed light
 of Heaven? And shall any man be indifferent
 about the blessed light of true principles?
~~There are many, I am sure, who are not~~
~~interested & grounded in the doctrine of~~
~~proximate cause, & who are not~~

Finis.

exceeding 100, are so reviews & terms of our imperfect

[Faint, mostly illegible handwritten text, possibly a letter or journal entry, covering the majority of the page. The ink is light and the paper shows signs of age and staining.]

[Faint handwritten text visible on the right edge of the page, likely from the adjacent page.]